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Soil Survey

of

York County, Nebraska

By

F. A. HAYES, in Charge, and A. W. GOKE

Bureau of Chemistry and Soils

In cooperation with the University of Nebraska State Soil Survey
Department of the Conservation and Survey Division

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CONTENTS

SOIL SURVEY OF YORK COUNTY, NEBRASKA

By F. A. HAYES, in Charge, and A. W. GOKE

COUNTY SURVEYED

York County is in southeastern Nebraska. (Fig. 1.) York, situated in the central part of the county, is 50 miles west of Lincoln. The county is almost square, each boundary being about 24 miles long. It comprises 575 square miles, or 368,000 acres.

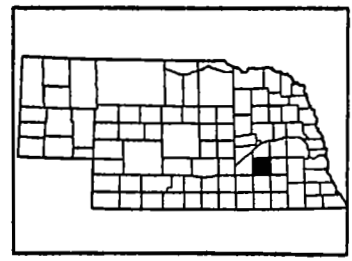

FIGURE 1.—Sketch map showing location of York County, Nebr.

York County is in the loess region of Nebraska. Most of eastern and southern Nebraska was once a broad nearly level or rolling plain. It was mantled with loess, a smooth silt deposit, in some places more than 100 feet thick. Parts of the old constructional surface have been eroded by wind and water and in many places, especially in counties to the east, the loessial mantle has been entirely removed over large areas. In York County, however, most of the land surface is near the level of the old constructional plain, and modification has occurred only in comparatively narrow strips along drainage ways.

About 85 per cent of York County is upland. The remainder is alluvial land occupying the broad shallow valleys along the major streams.

The relief of the uplands ranges from nearly level to strongly rolling. By far the greater part of the land is very gently undulating and is characterized by numerous shallow basinlike depressions which range in size from a few square rods to several hundred acres.

Gently rolling uplands occupy about 6 square miles south of West Fork Big Blue River in the eastern part of McFadden Township. The land surface in this locality is characterized by numerous broad rounded ridges and hillocks which are from 10 to 15 feet high and have gently sloping sides. The relief appears to have been caused by stream erosion, but most of the shallow drainage ways have evidently become blocked in the past by wind-blown silts, as is indicated by numerous basinlike depressions similar to those in the gently undulating uplands but slightly deeper.

The most strongly rolling parts of the uplands are the direct result of erosion. They are confined to sloping areas along the valley sides of the major streams and their tributaries. The slopes, although numerous, are in few places more than one-fourth of a mile wide on either valley side and occupy only a small part of the upland surfaces. Most of those along the major streams are rather gradual,

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but many of the smaller tributaries have cut rather abruptly into the loose loessial deposit, and their valleys, although narrow and shallow, are in many places marked by steep slopes.

The alluvial lands, which include the terraces and flood plains, occur as continuous strips of various widths along the larger streams. The widest developments are along Big Blue River, West Fork Big Blue River, Lincoln Creek, and Beaver Creek, where the width ranges from three-eighths of a mile to about 1½ miles. Narrower strips are along many of the tributaries to these streams.

The average elevation of York County is about 1,650 feet above sea level. The altitude ranges from about 1,500 feet where West Fork Big Blue River crosses the eastern boundary to about 1,740 feet near Arborville in the extreme northwestern part of the county. The general upland level averages about 60 feet above the alluvial lands along Beaver and Lincoln Creeks, 40 feet above those along Big Blue River, and ranges from 60 to 100 feet above those along West Fork Big Blue River. The general slope of the county is to the southeast.

All the streams of York County have fairly steep gradients and are actively deepening their channels. Water power is developed on Lincoln Creek north of Thayer. Most of the smaller drainage ways are widening their valleys in their lower courses and are rapidly extending their channels through headward erosion into the loose loessial deposit of the uplands.

Well water of excellent quality is readily obtained in all parts of the county. The upland wells range in depth from 60 to 120 feet, most of them extending to a sand sheet underlying the loess mantle. The wells throughout the alluvial lands are from 20 to 60 feet deep.

Native forest grows in narrow belts along all the larger drainage ways. It consists chiefly of willow, cottonwood, boxelder, elm, and ash, interspersed with some hackberry and walnut, and is of value chiefly for livestock and wild-life protection and for firewood and post material. Planted groves of ash, elm, and cottonwood serve as windbreaks to protect the farm buildings on many farms.

The first permanent settlement in the area now included in York County was made in the valley of West Fork Big Blue River in 1865. The county was attached to Seward County for judicial, revenue, and election purposes until 1870, when it was organized as a separate unit, and since that time its boundaries have remained unchanged. The early settlers came largely from the East Central States. They were of many nationalities, but the majority were of American birth.

According to the census the population of the county was 604 in 1870, 11,170 in 1880, 17,279 in 1890, 18,205 in 1900, 18,271 in 1910, 17,146 in 1920, and 17,239 in 1930. The 1930 census classes 66.9 per cent of the population as rural. The entire urban population is included in the city of York. The last census gives the density of the total population as 21.3 persons to the square mile. In 1920, 92.2 per cent of the inhabitants were native white persons, 7.7 per cent were foreign-born whites, and 0.1 per cent were negroes. The people of foreign birth are principally from Germany and the Scandinavian countries. The rural population, except in the towns and villages, is rather evenly distributed.

York, the county seat, had a population of 5,712 in 1930. This city is an important educational and railroad center and furnishes good market and distributing facilities for farm products, implements, and supplies. A number of towns and villages are conveniently located throughout the county, serving as local markets for their respective communities.

The transportation facilities of York County are good. Branch lines of the Chicago, Burlington & Quincy Railroad and the Chicago & North Western Railway cross the county in several directions and make good connections with Omaha, Lincoln, Grand Island, and Hastings. No point in the county is more than 9 miles from a railroad.

The public-road system is well developed. United States Highway No. 81 crosses the central part of the county from north to south, and a State highway crosses the central part from east to west. Both highways are surfaced with gravel. Most of the other roads, which usually follow section lines, are of earth construction but are kept in excellent repair. Cement bridges and culverts are common on nearly all roads.

All parts of the county are supplied with rural mail delivery, telephones are in common use, and the public-school system is highly developed.

CLIMATE

The climate of York County is well suited for growing hay, vegetables, and grain crops, and for raising livestock. In spring the weather is usually cool, with considerable rain, which favors rapid growth of winter wheat and spring-planted small grains. The long summers, with warm days and nights, are especially favorable to corn. The autumns are long and pleasant, with only occasional periods of rainy weather, giving the farmer ample time to prepare and seed the land for winter wheat and to harvest the corn crop. Low temperatures sometimes occur in winter but are often accompanied by snow which usually protects winter-grown crops from serious injury.

There is not sufficient variation in relief within the county to cause any appreciable differences in climate. Table 1, compiled from the records of the Weather Bureau station at York, gives the normal monthly, seasonal, and annual temperature and precipitation.

The mean annual temperature is 51.5° F. There is a range of 52.1° between the mean temperatures of January and July, the coldest and warmest months, respectively. The lowest temperature recorded is −31°, in February, and the highest is 112°, in both July and August.

The average date of the last killing frost is April 29 and that of the first is October 7. This gives an average frost-free season of 161 days, which is ample for maturing all farm crops common to the region. However, during the 20 years from 1895 to 1914 there were 4 years in which killing frosts occurred 10 or more days earlier than the average date, and 4 years in which they were 10 or more days later. Killing frosts have been recorded as late as May 27 and as early as September 12.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at York, Nebr.*

[Elevation, 1,633 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1894)	Total amount for the wettest year (1908)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	27.6	70	−23	0.83	0.19	(1)	5.0
January	25.0	67	−28	.58	.16	0.45	4.3
February	26.6	80	−31	1.18	1.00	1.53	6.9
Winter	26.4	80	−31	2.59	1.35	1.98	16.2
March	38.8	91	−11	1.24	1.00	.49	5.6
April	51.8	98	14	3.06	2.13	1.12	2.4
May	61.3	102	21	4.00	1.33	6.59	.6
Spring	50.6	102	−11	8.30	4.46	8.20	8.6
June	72.2	110	38	3.98	4.16	10.94	.0
July	77.1	112	44	3.79	1.32	8.38	.0
August	75.8	112	39	3.26	.33	5.28	.0
Summer	75.0	112	38	11.03	5.81	24.60	.0
September	67.2	107	26	3.10	1.35	1.04	(1)
October	54.5	94	10	1.90	1.61	2.40	.8
November	39.8	97	−4	.97	.15	1.11	1.8
Fall	53.8	107	−4	5.97	3.11	4.55	2.6
Year	51.5	112	−31	27.89	14.73	39.33	27.4

[1] Trace.

About 66 per cent of the mean annual precipitation of 27.89 inches falls during the principal part of the growing season, from April to August, inclusive. The precipitation, however, varies greatly from year to year. The total precipitation in the driest year on record (1894) was 14.73 inches and in the wettest year (1908) was 39.33 inches. The driest months are November, December, and January, the mean annual precipitation of each being less than 1 inch.

In summer the precipitation usually occurs as heavy thundershowers, though torrential rains are rare. Droughts are almost unknown during May and June, but in the latter part of July and throughout August the rainfall varies considerably, and short dry periods may occur. However, crops seldom suffer from lack of moisture when proper cultural methods are followed, as nearly all the soils have a high water-retaining capacity. The annual snowfall ranges from a few inches to several feet, averaging 27.4 inches.

From October 1 to April 1 the prevailing wind is from the northwest, and during the rest of the year it is from a southerly direction. Strong winds are common, but tornadoes are rare.

AGRICULTURAL HISTORY AND STATISTICS

York County is essentially an agricultural county. Prior to the entry of white men the land was covered with a luxuriant growth of prairie grasses, with marginal strips of tree growth along the

larger streams. Much of the woodland still remains, but most of the prairie sod has been broken for crop production.

In 1861 the Nebraska City Cut Off, a branch of the old California Trail, was extended from Nebraska City to Kearney, crossing the area now included in York County. In 1863 and during the next few years temporary ranches were located along this road. They furnished accommodations and supplies for emigrants en route to western points, and a few were official relay stations for the overland stagecoach.

Corn, potatoes, and garden vegetables were grown in a small way by the early ranchers for home consumption and for sale to emigrants. The yields were good, and the farming possibilities of the land became apparent.

The first permanent settlement was made in section 2, T. 9 N., R. 1 W., on West Fork Big Blue River in 1865. This was followed by additional settlements along streams where food and water were plentiful. Settlement in the uplands was slow. In 1877 the first railroad, the Midland Pacific, now known as the Burlington, reached York, and during the next few years the land was rapidly homesteaded.

The first crops planted by the settlers were corn, spring wheat, flax, and vegetables. These food products were supplemented with milk, pork, and game. Very few cattle were raised. Ranching was followed to some extent but never became important, as larger returns were obtained from the sale of grain crops.

According to the Federal census the value of all crops produced in York County in 1924 was $6,962,474. Dairy products were produced to the value of $252,841, and poultry and eggs to the value of $491,233. The total value of all domestic animals on farms in the county on January 1, 1925, was $3,212,166.

About 90 per cent of the land in the county is suited for cultivation, and about 80 per cent of the cultivable land is in use. Corn is by far the most important crop, followed by wheat, oats, alfalfa, wild hay, sweetclover, rye, timothy and clover mixed, barley, and potatoes, ranking in acreage in the order named. Minor crops include sorghum, millet, kafir, garden vegetables, and fruits.

Table 2 gives the acreage and production of the principal crops in the county. The figures for the decades from 1879 to 1919 are from the Federal census reports, and those for 1927 are from the Nebraska agricultural statistics.

TABLE 2.—*Acreage and production of principal crops in York County, Nebr., in stated years*

Crop	1879		1889		1899	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	48,421	2,075,243	125,874	6,139,525	141,178	3,895,820
Wheat	77,729	789,183	2,945	37,058	45,715	595,670
Oats	7,868	205,267	52,543	1,453,554	56,514	2,005,700
Rye	1,388	13,055	673	11,485	6,007	91,740
Barley	6,171	90,159	456	10,005	7,995	229,660
Potatoes		59,356	1,685	156,720	1,528	194,807
		Tons		*Tons*		*Tons*
Wild hay	11,605	15,254	36,918	41,339	14,576	12,398
Alfalfa					1,023	2,630
Coarse forage					496	1,421

TABLE 2.—*Acreage and production of principal crops in York County, Nebr., in stated years*—Continued

Crop	1909		1919		1927	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	123,583	3,909,588	99,038	2,048,345	136,462	4,912,632
Wheat	86,141	1,913,971	102,686	1,458,279	79,283	1,743,698
Oats	32,253	786,152	27,036	1,029,356	35,285	952,695
Rye	76	1,303	1,432	23,327	1,480	26,640
Barley	1,034	20,938	3,404	84,861	1,266	36,714
Potatoes	955	81,830	710	35,290	618	52,530
		Tons		*Tons*		*Tons*
Wild hay	9,250	10,445	5,329	5,313	5,666	6,233
Alfalfa	9,390	26,490	19,179	40,868	19,346	52,234
Timothy and clover (mixed)	11,452	15,291	1,345	1,904	1,288	1,719
Sweetclover					[1] 5,533	1,826
Coarse forage	184	697	4,683	11,296	505	1,566

[1] Includes acreage pastured.

The returns derived from livestock are an important source of revenue in York County. According to the Nebraska agricultural statistics the value of livestock and their products was more than half as large as that of all farm crops in 1927.

Table 3 compiled from the Federal census reports and from the 1927 Nebraska agricultural statistics, gives the number and value of domestic animals, poultry, and bee colonies in the county in 1900, 1910, 1920, and 1927.

TABLE 3.—*Number and value of domestic animals, poultry, and bees in York County, Nebr., in stated years*

	1900		1910		1920		1927 [1]	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Cattle	30,140		26,573	$698,523	27,517	$1,507,749	26,049	$1,123,137
Swine	64,732		50,543	433,886	48,223	1,061,329	65,819	1,151,833
Horses	12,431		15,285	1,682,253	12,492	1,184,980	10,792	601,945
Mules	993		1,529	212,812	1,565	206,391	1,596	110,028
Sheep	1,406		666	2,706	1,647	21,576	7,623	66,076
All poultry	117,343	$40,755	146,202	73,032	195,717	183,643	231,728	202,994
Colonies of bees	1,298	5,003	961	2,716	605	3,006	529	
Total value of all domestic animals [2]		[2] 1,805,586		[2] 3,034,132		[2] 3,986,322		3,256,013

[1] 1927 data taken from Nebraska agricultural statistics.
[2] Census totals include asses, burros, and goats not given in table.

The farm buildings are, in general, well painted and kept in good repair, and many of the houses are equipped with modern conveniences. In 1927, 318 of the farmhouses had modern heating plants; 293 had lighting systems; 376 had modern water systems; and 703 had radios. The farms are fenced, mainly with barbed wire, though many farms are inclosed with hog-tight woven-wire fencing. The work animals include heavy draft horses and mules. There were 350 gas tractors, 136 trucks, and 2,064 automobiles on farms in 1927. The farm machinery is of the most modern and labor-saving types, including gang or sulky plows, disks, harrows, drills, listers, corn planters, mowing machines, cultivators, rakes, hay loaders, stackers, binders, manure spreaders, and wagons. There were 248 grain threshers, 5 wheat combines, and 725 cream separators in the county

in 1927. Many farms are equipped with corn binders, corn shuckers, hay balers, and incubators. The more expensive farm machinery is sheltered.

In general, farm laborers are plentiful except during small-grain harvest, when good help is often scarce. Wages range from $30 to $50 a month with board and lodging. Day labor commands from $2.50 to $3.50, and during harvest season from $4 to $5 is paid. Wheat is threshed for 6 or 7 cents a bushel and oats for 3 or 4 cents. Corn shuckers usually receive from 4 to 6 cents a bushel. Many farmers hire help by the year in order to insure an adequate supply at critical periods.

The Federal census reports show that 95.8 per cent of the land in the county was in farms in 1925 and that a large proportion of the farm land was improved. The size of farms ranges from 80 to 320 acres, averaging 166.7 acres.

In 1925, owners occupied 950 farms, tenants 1,156 farms, and managers 8 farms. The proportion of tenant farms increased greatly between 1900 and 1920 but has declined slightly since the last date. Both cash and share systems of rental or sometimes a combination of the two are followed. The share system is most popular, 83 per cent of the rented land being rented on shares in 1927. Under this system the owner receives two-fifths of the grain delivered and from $3 to $5 an acre for the pasture land and building site. All seed, labor, and machinery are furnished by the tenant. When alfalfa land is rented on shares, it is common custom for the owner to receive half the hay stacked in the field. Under the cash system it is customary for the tenant to pay from $6 to $8 an acre for the use of the land, including the pasture areas. Land suited only for pasture may be rented for a lump sum. On some farms the renter is allowed the use of the pasture land without charge. Very little of the land suited for grain production is rented for cash.

The Nebraska agricultural statistics record 45 land sales during the 12 months preceding March 31, 1927. These sales involved 4,469 acres of land, and the average price obtained was $126.02 an acre. The selling price of individual farms ranges widely, depending on the character of the soil, topography, drainage, improvements, and location with respect to markets.

AGRICULTURAL INDUSTRIES

As in eastern Nebraska generally, grain growing is the principal industry in York County. Much attention, however, is given to fattening cattle and raising hogs. Dairying, poultry production, and the raising of work animals are minor industries.

Wheat is the chief cash crop. Grain elevators are established in nearly every town, and most of the grain is hauled directly from the threshing machine to the elevators, where it is sold and shipped to outside markets. Some farmers store their wheat for a more favorable price than commonly prevails during the harvest season. A few sell to local millers. Most of the other feed crops are used on the farms where produced or are sold to local feeders.

Potatoes, fruits, and garden vegetables are grown only for home consumption.

Small orchards consisting of apple, cherry, peach, pear, and plum trees are on many farms. The trees grow well and in favorable seasons produce good yields of fruit. The prevalence of late spring frosts, however, makes fruit production very uncertain, and there are no commercial orchards in the county. Of the wild fruits, grapes and plums are the most important. They grow chiefly in the first bottoms along the larger streams.

Some of the cattle to be fattened are raised locally, but the greater part are purchased either in the Omaha markets or from ranchers in more western counties. The feeder cattle are fed corn and alfalfa from 60 to 90 days and are then shipped to Omaha or Chicago. A few farmers feed cattle by contract. Under one form of contract the owner delivers the cattle to the farmer and allows him so much a pound for all gain in weight, and at the end of the feeding period the owner ships the animals to market. Another system is to allow the farmer a few dollars a head, plus the market price for all grain and hay used in fattening. Most of the beef cattle are of Hereford or Shorthorn breeding.

Each farmer raises from 20 to 60 hogs a year, and a few have herds of several hundred. Practically all the hogs are raised on corn and alfalfa, although barley and rye are sometimes added to the ration. Many hogs are raised in connection with the feeding of beef cattle. There are numerous purebred herds in the county, and all the hogs are of good breeding, Duroc-Jersey, big-type Poland China, and Hampshire breeds predominating. Practically all the hogs shipped to market are raised and fattened on the farm, and most of them are sold in Omaha. Cholera has at times disastrously affected hog raising, but the disease has been largely controlled during recent years by vaccination and increased sanitation.

Dairying is gradually being extended in connection with general grain farming. There are comparatively few purebred dairy cattle in the county, but enough to serve as a basis for developing the dairy industry. Good marketing facilities and the abundance of alfalfa to balance the corn ration combine for favoring the extension of the dairy industry. Only a few farms are devoted to dairying exclusively, but from 6 to 10 cows are kept on the average farm. The purebred dairy cattle are chiefly Holsteins. Many farmers have cream separators. Most of the dairy products are sold at local cream stations from which they are shipped to creameries in the large cities.

Sheep raising receives little attention, but several thousand sheep are annually shipped into the county for feeding. The animals are fattened on corn, alfalfa, and sweetclover, and are sold in the Omaha market.

Most of the farmers raise their own work animals.

Poultry is a valuable asset on most farms, and on a few farms includes chickens, turkeys, ducks, geese, and guinea fowl. The local demand for poultry products is good, and poultry is receiving increased attention. The principal breeds of chickens are Plymouth Rock, Leghorn, and Rhode Island Red.

SOILS AND CROPS

All the soils in York County except those on severely eroded slopes or recently deposited or exposed sands, which are not exten-

sive, have dark-colored, almost black topsoils. The topsoils, however, differ in thickness. The subsoils also differ, ranging from loose incoherent sand to dense, comparatively impervious clay. These differences directly control the storage of available moisture in the topsoil and subsoil and therefore influence the distribution and yields of crops. The depth to the underlying water table also influences the distribution and yields of certain crops, particularly alfalfa and small grains.

In this report as a matter of convenience, the upland and the alluvial soils will be considered separately, although such a grouping is not entirely justified on the basis of either soil characteristics or crop adaptations; but, in the mind of the farmer, the alluvial soils are considered as distinct from the upland soils.

Throughout the uplands differences in the thickness of the topsoils and in the compaction of the subsoils seem to bear a close relationship to differences in the drainage conditions under which the soils have developed or are developing. The upland soils, therefore, may be placed in three groups, namely, well-drained, poorly drained, and excessively drained soils.

All the soils of the county are used more or less extensively for all crops commonly grown in the county, but the proportional acreage of any particular soil devoted to a certain crop depends on the relationship of the available moisture supply in that soil to the moisture requirement of the crop.

Of the cereal crops common to the county, corn has the largest root system and matures the latest. It requires an abundant and continuous water supply throughout the summer and naturally does best on those soils containing the largest amounts of available moisture. Small-grain crops having smaller root systems and maturing earlier than corn do not require moisture in such large amounts or for such long periods and, consequently, do better than corn on soils with comparatively low moisture-storing capacities. Alfalfa, the leading tame-hay crop in the county, requires even more moisture than corn, and the moisture for this crop must come largely from a great depth because the roots of the alfalfa plant extend much deeper than those of the common cereal crops. Alfalfa, therefore, does best on soils with abundant moisture at a depth of several feet below the surface of the ground.

Throughout the uplands the well-drained soil, Hastings silt loam, meets the moisture requirements of corn better than any other upland soil, and about 80 per cent of the land is devoted to this crop. The topsoil, being deep, granular, and well supplied with organic matter, is highly retentive of moisture, and the subsoil also has a high storage capacity for available moisture. The topsoil and subsoil both allow easy penetration and therefore unlimited feeding range for the corn roots. Wheat and oats also do better on Hastings silt loam than on any other soil in the uplands and occupy most of the area not in corn, wheat being grown on about twice the acreage devoted to oats. Small-grain crops are less profitable than corn on all the soils of the county where moisture conditions are favorable for the latter crop.

Alfalfa occupies a very small acreage in the well-drained soil group. This crop is of minor importance on the upland soils where it is used only occasionally in rotations between corn and wheat.

The crop does well during the first few seasons but, as on nearly all upland soils in Nebraska, the yields decline after 5 or 6 years, on account of insufficient moisture. A second cropping to alfalfa on these soils is seldom as profitable as the first. The alfalfa plant has an exceptionally large root system and extracts soil moisture from a considerable depth. A recent publication by agronomists at the Nebraska Agricultural Experiment Station [1] shows that on soil receiving moisture from precipitation alone, as do all the upland soils of York County except those in the depressions, alfalfa can deplete the stored soil moisture to depths far beyond the reach of ordinary cereal crops within 2 years, and that within 5 or 6 years it can almost completely exhaust the available moisture in the substratum to depths exceeding 25 feet. In that publication it is estimated that under present climatic conditions it would require about 225 years to replace the original moisture content of the substratum.

The removal of deep-seated moisture does not materially affect grain crops, but unfavorable yields of grain crops following alfalfa on upland soils often occur because the alfalfa has depleted the water supply to such an extent that insufficient water remains to provide for the increased growth of grain resulting from the added nitrogen stored in the soil by the alfalfa crop. Grain crops following alfalfa on the upland soils should consist of early-maturing varieties, and the seeding should be at somewhat less than the normal rate in order to decrease the moisture requirement.

Sweetclover instead of alfalfa in rotations on upland soils is recommended by the Nebraska Experiment Station agronomists. This crop requires less moisture than alfalfa and is adapted to shorter rotations. It equals alfalfa in its ability to increase the available nitrogen content of the soil and is being grown more extensively each year.

The poorly drained upland soils occupy the depressed areas within soils of the well-drained group. They receive more moisture than any other upland soils. About 20 per cent of the area occupied by them is periodically too wet for cultivation and is used for pasture and hay land. In the cultivable areas the topsoils are usually saturated with moisture in early spring, but in the latter part of summer they often become extremely dry, especially in seasons of low rainfall. The heavy claypanlike subsoils release their water very slowly. Moisture conditions are very unfavorable for corn because the abundant topsoil moisture in early spring causes the corn to make an unusually heavy vegetative growth which is poorly adapted to endure the dry conditions prevailing in the soils during late summer. Winter wheat, therefore, is the chief crop on the cultivable parts of the poorly drained upland soils, occupying about 70 per cent of the farmed land. This crop can be planted in late summer when the soil is sufficiently dry for plowing and seeding. It grows very rapidly during early spring and usually matures before the topsoil moisture is exhausted. Oats and sweetclover occupy most of the cultivable land not in wheat. Oats do as well as wheat, provided moisture conditions are favorable for planting the

[1] KIESSELBACH, T. A., RUSSEL, J. C., and ANDERSON, A. THE SIGNIFICANCE OF SUBSOIL MOISTURE IN ALFALFA PRODUCTION. Jour. Amer. Soc. Agron. 21: 241–268, illus. 1929.

grain at the proper time in the spring. Sweetclover, being adapted to both moist and dry soil conditions, does well on the poorly drained soils of the uplands unless the moisture conditions are extremely excessive.

The excessively drained upland soils, owing to comparatively thin topsoils and subsoils, have lower moisture-storing capacities than the well-drained soils and are not so well suited to corn. However, the excessively drained soils do not have the claypanlike subsoil layers occurring in the poorly drained upland soils and will grow profitable yields of corn except on a few of the steeper slopes which are unsuited to cultivation. The approximate acreage percentage of corn, wheat, and oats on these soils is 45, 30, and 10, respectively. The remaining 15 per cent is used for sweetclover, alfalfa, and, in the more steeply sloping areas, for pasture or wild hay.

Throughout the alluvial soil group of York County, approximately 90 per cent of the land is under cultivation. Those parts not used for cultivated crops include a few poorly drained areas and narrow woodland strips on the first bottoms adjacent to the stream channels.

The proportional acreage devoted to alfalfa on the alluvial soils is much greater than on the uplands. These soils naturally receive some water through run-off from higher land and in places through seepage from streams. Soils occupying the flood plains lie only a few feet above the ground-water level, and the lower part of their subsoils is almost continually wet. In the terrace soils the water table is somewhat deeper, averaging about 25 feet below the surface of the ground, but in most places it is easily reached by alfalfa roots. Alfalfa can be grown continuously on practically all the alluvial soils of the county without depleting the moisture in the lower part of the soil to the point where yields decline.

Although the high moisture content in the alluvial soils makes them especially suited for alfalfa production, it also makes them the most productive corn soils in the county, and since corn is more profitable than alfalfa it is grown more extensively. Wheat follows corn in acreage on the terrace soils, but owing to the high moisture content of the soil it has a tendency to produce rank vegetative growth at the expense of the grain, especially in seasons of heavy precipitation. Even in normal years wheat yields average no higher than on Hastings silt loam of the well-drained upland soil group. Wheat is of minor importance on the flood-plain soils.

The approximate percentage of the cultivable alluvial soils devoted to corn, wheat, and alfalfa is 60, 30, and 10, respectively, on the terraces and 75, 10, and 15, respectively, on the first bottoms.

A few fields of oats, rye, or barley were seen on the alluvial soils during the progress of this survey, but the total area devoted to these crops is practically negligible.

In the following pages of this report the different soils indicated on the accompanying map are described, their relation to one another is shown, and their influence on the agricultural development and farming practices of the county is discussed. Table 4 shows the acreage and proportionate extent of the soils.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in York County, Nebr.*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Hastings silt loam	248,890	67.6	Waukesha silt loam	26,496	7.2
Scott silt loam	11,328	3.1	Hall silt loam	5,440	1.5
Fillmore silt loam	5,952	1.6	Judson silt loam	320	.1
Butler silt loam	5,248	1.4	Wabash silt loam	10,688	2.9
Creto silt loam	1,792	.5	Cass very fine sandy loam	1,664	.4
Hastings silt loam, slope phase	49,216	13.4			
Nuckolls loam	320	.1	Total	368,000	
Shelby loam	640	.2			

WELL-DRAINED UPLAND SOILS

The well-drained upland soils include only one soil type, Hastings silt loam. This soil is the most productive and extensive soil in the uplands, occupying about 76.9 per cent of the upland area. It has developed on the uneroded or only slightly modified surface of the old loess-mantled plain which once covered the entire region, and practically all the area occupied by it in York County is under cultivation. The relief is nearly level or very gently rolling, and conditions have favored the development of the soil characteristics most beneficial to crops.

Hastings silt loam.—Hastings silt loam occupies 388.9 square miles in York County. It includes all the uplands except those parts within the basinlike depressions and on the valley slopes along drainage ways. The agricultural development of York County, therefore, and the prosperity of the inhabitants depends to a considerable extent on the agricultural possibilities of this soil, the characteristics of which favor the production of all crops adapted to the climatic conditions of the region.

The climate for ages past has favored a luxuriant growth of prairie grasses. Good drainage without serious surface erosion has facilitated deep soil weathering.

The topsoil of Hastings silt loam is 18 or 20 inches thick and is well supplied with organic matter derived from the annual decay of grass roots. It is almost black silt loam, is very mellow, and has a well-developed crumblike or granular structure. The upper layer of the subsoil is grayish-brown silty clay loam about 12 inches thick, having a cloddy or nutlike structure. This layer averages a little more compact, especially in its upper part, than the topsoil, owing to a higher clay content and lower organic-matter content. Adequate surface drainage, however, has prevented excessive downward percolation of moisture, and the subsoil has not received sufficient fine material from the topsoil to render it extremely compact. It does not restrict root development or the upward and downward movement of soil moisture, and there is no evidence of a claypan. The lower part of the subsoil is almost white floury silt which is very limy below a depth ranging from 48 to 60 inches, as shown by effervescence when dilute hydrochloric acid is applied. The lime occurs as numerous small white nodules and also in finely divided form thoroughly mixed with the soil material. The transition between the different soil layers is very gradual.

Hastings silt loam is more productive than any other soil in the county except Crete silt loam and the fine-textured and better-drained bottom-land and terrace soils, which have a slight moisture advantage over Hastings silt loam, especially for corn and alfalfa production. The high organic-matter content of the topsoil assists the soil to absorb the sun's heat and maintain a uniform temperature and greatly increases the water-holding capacity of the soil material, thereby insuring considerable protection against crop failure during droughts. It materially increases the stability of the mineral soil particles and assists in maintaining the soil in favorable tilth. Organic matter is the chief source of nitrogen, which is one of the most important plant foods in the development and maintenance of healthy vegetative growth. The granular or crumblike structure, so well developed in the topsoil, facilitates penetration and therefore provides the maximum feeding range for crop roots. It allows free passage of air which, in combination with the soil moisture, changes the raw organic and mineral constituents of the soil into suitable food for the growing crops. Moreover, the granular structure improves the soil tilth by restricting soil puddling, baking, and clodding. It facilitates cultivation under a wider range of moisture conditions than would be possible were the structure particles extremely fine.

Crop yields on Hastings silt loam, particularly those of corn, are a little more variable than on the best upland soils of States farther east, largely because of greater variation in the summer rainfall. Crop production on this soil, however, compares favorably with that on the leading upland soils of the Mississippi Valley. Corn yields from 25 to 65 bushels to the acre, with an average of about 36 bushels; wheat, from 12 to 60 bushels; oats, about the same as corn; rye, about the same as or a little less than wheat; barley, about 25 bushels; and alfalfa hay, from 2 to 3 tons during the first 5 or 6 year cropping period.

POORLY DRAINED UPLAND SOILS

The poorly drained upland soils include the Scott, Fillmore, Butler, and Crete soils. These soils occur in shallow basinlike depressions, locally called "buffalo wallows" or "lagoons," throughout soils of the well-drained group. Few of the numerous depressions exceed 640 acres in size, and many of them occupy less than 5 acres.

Variations in the amount of excess moisture have caused variations in the characteristics, producing powers, and crop adaptabilities of the soils in the different depressions and also in different parts of the same depression. The soils subjected to the least excess moisture have black granular topsoils similar to the corresponding layer in the well-drained upland soils except that they are a trifle thinner and most of them contain more clay. The soils subjected to a greater excess of moisture have decidedly thinner topsoils, which in many places are rather light, especially in the lower part, owing to excessive leaching. The upper subsoil layers of soils of this group are extremely dense and claypanlike. The lower subsoil layers, however, are loose and light colored, and, except in the wettest areas, are limy.

These soils, with the exception of Crete silt loam, have either low or uncertain producing powers on account of their poor drainage and the heavy claypanlike character of their upper subsoil layers.

Scott silt loam.—The most poorly drained and most extensive soil of the poorly drained group is Scott silt loam. It usually occupies the deepest depressions or parts thereof throughout the uplands and has apparently been subjected to excessive moisture in larger amounts and for longer periods than any other soil. Typical developments of this soil occur southwest and northeast of Charleston, southeast of York, south of Arborville, and northwest of Waco.

The topsoil, ranging from less than 6 to about 10 inches in thickness, is rather heavy silt loam which is somewhat variable in structure but lacks the pulverulent granular character of the corresponding layer in Hastings silt loam. The upper one-half to three-fourths of the layer is almost black, owing to an abundance of well-decomposed organic matter, but it is usually lightly sprinkled with light-gray or almost white floury silt. The lower part may or may not be dark, but is generally more leached than the overlying material and in places is almost white. The subsoil, which extends to a depth ranging from 5 to 6 feet, consists of mottled steel-gray and bluish-gray heavy clay which is extremely impervious to water and when dry is difficult to penetrate with a spade or auger. The excessive moisture has removed all traces of lime from both surface soil and subsoil so far as can be determined by the usual field methods.

Scott silt loam is considered the most difficult to handle and the least productive of the upland soils in York County, but it yields fairly well in favorable years if adequately drained and well managed. It does not react favorably to cultivation except under a very narrow range of moisture conditions. If plowed when wet, hard clods are formed, and subsequent freezing and thawing or wetting and drying are required to restore favorable tilth. The soil is extremely difficult to plow when dry. Corn does fairly well, sometimes yielding 30 or 35 bushels to the acre in seasons of normal precipitation, providing good surface drainage is assured. In dry years, however, the corn yield on this soil barely defrays the expense involved in seed and labor, because the topsoil is too thin to retain sufficient moisture and the compact subsoil releases its moisture too slowly for the growing crop.

Of the grain crops, wheat seems to give the best results in dry years. It usually matures before the moisture which was stored in the topsoil during the winter months is depleted and often yields from 15 to 18 bushels to the acre. In wet years, however, wheat usually produces a rank vegetative growth at the expense of the grain.

Sweetclover is considered an excellent crop to use in rotations on Scott silt loam. The crop is adapted to either moist or dry soil conditions but seldom does well if the land is exceedingly wet. It should be grown only in those areas which have fair or good drainage. Sweetclover not only increases the organic-matter content and therefore the water-absorbing power of the topsoil, but its large vigorous roots are able to penetrate the heavy claypan and, on decaying, leave openings which improve the natural drainage, aeration, and physical condition of the subsoil.

Scott silt loam is in many places difficult to drain, as most of the surrounding land is higher. The increased returns obtained by drainage seldom warrant the expense involved in ditching or tiling

the land, especially the smaller areas. Unless the surplus surface moisture can be economically directed into near-by roadside ditches or some natural drainage way, few of the bodies of Scott silt loam are artificially drained.

Only about 50 per cent of this soil is under cultivation. The uncultivated areas, which support a luxuriant growth of grasses and weeds or rushes and sedges, are used for pasture and hay.

Fillmore silt loam.—Fillmore silt loam occurs in basinlike depressions throughout the uplands and most of the soil is poorly drained but has evidently not been subjected to such excessive moisture as the Scott soil. The topsoil material is a trifle more granular and averages 2 or 3 inches thicker than that of Scott silt loam, and therefore affords a little larger and a slightly more efficient reservoir for moisture and plant food.

The upper subsoil layer is more dense and claypanlike than the corresponding layer of any other soil in the county. It is almost black in contrast to the mottled steel-gray and bluish-gray subsoil of the Scott soil. The lower subsoil layer, below a depth of about 40 inches, is light-gray loose silt which is very limy.

About 60 per cent of the Fillmore silt loam is under cultivation to the same crops as are grown on Scott silt loam, and in years of normal precipitation yields are about the same as those on the Scott soil, but in dry years the Fillmore soil produces a little higher yields. Profitable crop yields are not obtained in all years on either soil. Artificial drainage and the growing of sweetclover are as beneficial to this soil as to Scott silt loam. The two soils require similar handling.

The uncultivated parts of Fillmore silt loam, which are used for pasture land, support a rank growth of water-loving grasses and weeds but few rushes and sedges.

Butler silt loam.—The topsoil of Butler silt loam is almost black and is rich in organic matter. It is deeper than that in the Fillmore soil, being from 15 to 17 inches thick. This soil occupies slightly depressed areas throughout the uplands, and although occasionally inundated unless artificially drained, it has evidently been subjected to less excessive moisture than Fillmore silt loam or Scott silt loam, as indicated by the crumblike or granular structure of its topsoil. This structure, which is practically absent in the Scott soil and is just beginning to form in the Fillmore soil, is well developed in Butler silt loam. The topsoil of the Butler soil shows less evidence of leaching than the corresponding layers in the Fillmore and Scott soils. A sprinkling of gray silt is present but is much less pronounced than in the Fillmore and Scott silt loams, and the light-gray leached layer which occurs in places in the lower part of the topsoil of those soils is absent. The subsoils of the Butler and Fillmore silt loams are similar in their major characteristics. Some technical differences occur but are of little agricultural importance and are described elsewhere in this report.

The topsoil of Butler silt loam is slightly thinner than that of the Hastings soil, and although granular it apparently has a higher clay content which tends to counteract the beneficial effects of granulation unless the soil is carefully managed. The Butler soil can not be cultivated without injury under so wide a range of moisture

conditions as the Hastings soil. This is well demonstrated in fields including both soils. If such fields are cultivated as soon after rains as moisture conditions in the Hastings soil become favorable, the associated Butler soil invariably puddles, bakes, and becomes cloddy, consequently losing an excessive amount of moisture through evaporation. The dense claypan layer in the Butler subsoil releases its moisture much more slowly than the more friable and porous subsoil of the Hastings soil, and when the available amount of moisture is depleted in the topsoil crops usually suffer from drought. Successful crop production on Butler silt loam, therefore, depends largely on the moisture stored in the topsoil.

Practically all of this soil is under cultivation, and it is considerably more productive than either Scott or Fillmore silt loam. It is adapted to all crops common to Hastings silt loam and in normal years is almost as productive, but in wet or dry seasons the yields are more variable than on the Hastings soil. In dry years the corn yield is reduced 10 or 15 per cent below that on Hastings silt loam, but the comparative yields of small grain are apparently not affected. In wet seasons the corn yield on the Butler soil usually equals that on the Hastings soil, provided the Butler soil is adequately drained, although small-grain crops generally yield lower.

More uniform yields on Butler silt loam could undoubtedly be maintained by providing artificial drainage and by exercising greater care in the conservation of soil moisture. The extra expense and labor involved in such treatment, however, is seldom warranted, as the soil usually occurs in small bodies and occupies an almost negligible part of the farm land.

Crete silt loam.—Crete silt loam as mapped in York County is not representative of typical Crete silt loam so extensively developed in the more southern counties of Nebraska. The Crete and Hastings soils of Nebraska are separated largely on the basis of differences in the density of the upper subsoil layer. The upper subsoil layer of Crete silt loam in York County, although considerably denser than the corresponding layer in Hastings silt loam, lacks the extreme compaction so characteristic of the true Crete soil. This layer is brown in contrast to the almost black color of the corresponding layers in the Butler and Fillmore soils, and it is not so dense. It allows sufficiently free water movement to prevent excessive accumulations of moisture in the topsoil during wet seasons and supplies considerable moisture to crop roots in dry periods.

The total area of Crete silt loam in York County is 2.8 square miles. The soil occurs in a few slightly depressed areas throughout the uplands, in close association with the Butler, Fillmore, and Scott soils. Most of the areas are north of Henderson in the southwestern part of the county. Surface drainage is adequate, as the soil occupies either the better-drained parts of the basins or basins having drainage outlets.

This soil is considered as productive and as well adapted to all the crops commonly grown in the county as Hastings silt loam, and it is handled in a similar manner.

EXCESSIVELY DRAINED UPLAND SOILS

The excessively drained upland soils include soils which occupy valley slopes where conditions have not been favorable for the forma-

tion of the deep dark-colored mature soils of the smooth upland. The greater part of the rainfall runs off immediately, and the amount that sinks into the ground is not sufficient to change the soil material and to produce many of the soil characteristics of the smooth areas. Consequently, the soil formation that takes place is very slow. The topsoil is so eroded by the rushing waters that the black soil is removed almost as rapidly as it forms. As a result the topsoils are thin and the raw unweathered material lies near the surface. In such soils the composition of the parent rock has a great influence on the soil. Each of the three soils of this group, Hastings silt loam, slope phase, Nuckolls loam, and Shelby loam, has a different parent material.

In a very few places the topsoils have been entirely removed, exposing the subsoils, and where erosion has been especially severe the geologic formations are exposed. On the more gradual slopes the topsoils may be rather thick in places and similar in all characteristics to the topsoils of soils in the well-drained group. In a few places the subsoils also are well developed. The variations in the soils of this group have been caused by local differences in erosion and are too patchy to indicate on a small-scale map.

The slope phase of Hastings silt loam covers valley slopes that have been cut into the deep loess of the uplands. Nuckolls loam and Shelby loam are associated with this soil in the southern part of the county where erosion has cut through the light-colored or gray loess mantle of the uplands, exposing the underlying formations. The layer immediately below the gray loess consists of reddish-brown silt loam or fine sandy loam and is known geologically as the Loveland phase of loess. It is considered much older than the gray loess formation from which the Hastings soils have developed and weathers into soil classed as Nuckolls loam in York County.

Below the Loveland phase of loess is a heterogeneous mass of sand, clay, and granitic cobblestones left by the ice during glacial times. This material where exposed by erosion has weathered into Shelby loam.

The topsoils of both Nuckolls loam and Shelby loam are somewhat variable, owing to differences in the amount of erosion to which they have been subjected. These soils are of little agricultural importance on account of their small extent and rather unfavorable relief. Their combined area is only 960 acres. They occur mainly in small bodies on the valley slopes along West Fork Big Blue River, and a few patches occupy similar positions along Beaver Creek in the eastern part of the county.

Hastings silt loam, slope phase.—The slope phase of Hastings silt loam occurs where the typical soil has been subjected to rapid erosion. It occupies the valley slopes along nearly all drainage ways in the county. The slopes, although widely distributed, are usually narrow, and the total area of this phase of soil is smaller than that of the typical soil. The soil differs from Hastings silt loam only in those characteristics which are the direct result of erosion, and the degree of difference to a great extent depends on the degree of slope.

Most of the valley slopes occupied by the phase are comparatively gradual, having from 10 to 15 per cent gradients, and do not seriously interfere with cultivation. The topsoil has been thinned

about 8 inches by erosion, or to about half the normal thickness of the corresponding layer in Hastings silt loam. The thinning has been accompanied by a proportional decrease in organic matter, in nitrogen, and in the moisture-retaining power of the soil, all of which are of primary importance in crop production.

In a few places the slopes are much steeper than those described, and cultivation is difficult or impossible under existing conditions. The black topsoil has become very thin and locally is entirely removed, exposing the lighter-colored subsoil. On some of the steepest slopes erosion has removed both surface soil and subsoil in places, and the almost white limy loess formation, from which all Hastings soils have weathered, is exposed.

All crops adapted to Hastings silt loam will grow on the slope phase of that soil, but reduced vigor, especially of corn and wheat, is very apparent in comparison with the luxuriant growth of the same crops on the typical soil. The limy subsoil and the parent loess formation, however, are moderately fertile in themselves, and the land remains fairly productive except in spots where the relief has become unsuited to cultivation. The slope phase of Hastings silt loam requires more careful management than the typical soil, but even under careful farming, yields of corn, wheat, and oats are about 10 per cent lower than those obtained on Hastings silt loam. Yields of sweetclover, however, and of the first crop of alfalfa are apparently not reduced because these crops are able to obtain most of their nitrogen from the air and their massive root systems can obtain moisture and food from greater depths and larger areas than those of most cereal crops. The use of sweetclover in rotations retards erosion, conserves the organic-matter content of the soil, increases its water-absorbing and water-holding capacities, and makes possible, under careful management, the use of the slopes for corn, wheat, and oats without injury to the soil. Alfalfa has the same beneficial effects for the first five or six years.

The prevention of erosion on the slope phase of Hastings silt loam is becoming more necessary each year. Although only small patches have become unsuited to cultivation, they are annually increasing in size, and all the soil has been more or less harmed either by sheet erosion or gullying.

Land unsuited to cultivation on account of gully erosion is difficult to reclaim. The extension of such land, however, may be prevented and cultivable land can be gradually restored by the construction, in gullies already formed, of earth or rubbish dams to check the velocity of run-off and cause the water to fill the gullies with sediment.

The removal of soil through sheet or surface erosion may be greatly reduced by maintaining a vegetative covering on the land as much of the time as possible. Deep plowing, which facilitates the absorption of moisture, is also beneficial. Corn on slopes subject to surface erosion should be planted, preferably with a lister, in rows extending at right angles to the direction of slope, so that the lister ridges may retard the velocity of run-off.

Feeding yards for cattle and hogs are commonly located on these slopes on account of the excellent drainage.

Nuckolls loam.—The average profile of Nuckolls loam in York County shows the following layers: A topsoil of moderately dark

loam from 3 to 5 inches thick, underlain by a layer, from 30 to 35 inches thick, of pale reddish-brown friable silt loam containing considerable clay and some very fine sand or fine sand. Below this layer the red tinge is slightly more pronounced and the material is extremely limy in spots, presenting a mottled reddish-brown and white appearance. In most places the material is similar in texture and consistence to the layer above, but in some places it is moderately compact. The lime occurs both in finely divided form and as numerous irregular-shaped concretions from one-fourth to almost 1 inch in diameter.

The topsoil is the most variable layer of the profile. On the more gradual slopes it may be 10 or 12 inches thick and much darker than usual. In steeper situations it may be greatly thinned by erosion, and on severely eroded slopes it is entirely absent and the pale reddish-brown subsoil layer is exposed.

Nuckolls loam in York County is used chiefly for pasture land, as most of the slopes on which it occurs are too steep or too badly gullied for profitable farming. The more gradually sloping parts of some areas occur in cultivated fields and seem well adapted to small grain.

More profitable utilization of this soil evidently depends on its reclamation from the disastrous effects of erosion. It could gradually be reclaimed for crop production through the application of measures suggested for controlling erosion on the slope phase of Hastings silt loam.

Shelby loam.—The topsoil of Shelby loam, as occurring in York County, is somewhat thicker and darker than that of Nuckolls loam, being almost black and ranging from 8 to 10 inches in thickness. In most places it is more granular than the corresponding layer of the Nuckolls soil, but it is similar in texture. The upper part of the subsoil is dark grayish-brown slightly compact clay loam containing considerable sand of various grades, together with a few pebbles. The lower part of the subsoil gradually becomes lighter and browner in color, without any noticeable change in texture or consistence, and at a depth of about 4½ feet the material gives way rather abruptly to a reddish-brown mixture of sand and gravel loosely held together with silt and clay. The subsoil does not contain sufficient lime to noticeably react with dilute hydrochloric acid.

The agricultural possibilities of Shelby loam and the methods necessary for its utilization are similar to those of Nuckolls loam.

ALLUVIAL SOILS

The alluvial soils of York County occur as almost continuous strips on terraces and first bottoms along all the larger streams of the county. The strips range from a few rods to more than a mile in width. Those along Big Blue River, West Fork Big Blue River, and Lincoln Creek are the widest.

All the alluvial soils except small parts of the areas occurring in the flood plains are well drained. The underlying water table, however, is much nearer the surface than throughout the uplands, and moisture conditions are especially favorable to those crops requiring a large and continuous moisture supply. The topsoils are deep, are well supplied with organic matter, and are very dark in color.

Five types of soil derived from alluvial or water-laid material have been mapped in York County—the silt loams of the Waukesha, Hall, Judson, and Wabash series and the very fine sandy loam of the Cass series.

The Waukesha and Hall silt loams occupy terrace or bench positions along streams. The surface of the benches is nearly level or very gently undulating except where modified by occasional shallow though steep-sided drainage tributaries leading to the trunk streams. The slope down the valleys and toward the main streams is sufficient to afford adequate surface drainage. No part of the benches is subject to destructive erosion.

Judson silt loam occurs on gentle colluvial slopes between the uplands and terraces or between the terraces and first bottoms. It is developed over material washed down from the surface layers of the upland soils. This material has been changed little since deposition and has a uniform texture to a depth of 3 or more feet.

Wabash silt loam and Cass very fine sandy loam occupy bottom-land or flood-plain strips bordering the channels of some of the larger drainage ways. The Wabash soil occurs chiefly along Lincoln and Beaver Creeks, and a few small areas are in the bottoms along West Fork Big Blue River. Cass very fine sandy loam is confined to the flood plains along the latter stream. The strips of bottom-land soils are not continuous and most of them are rather narrow, few of them exceeding one-fourth of a mile in width except along Lincoln Creek in the northeastern quarter of the county where the Wabash silt loam bottoms are almost a mile wide in places.

The surface relief of the flood plains is nearly level, although it is locally modified by old and present stream channels, slight elevations, and depressions. The land lies only a few feet above the normal flow of the streams and is subject to overflow in places during periods of high water. The slope is usually sufficient, however, down the valleys and toward the stream channels, to carry off the surplus moisture when the streams subside.

Owing to their small extent the Wabash and Cass soils are of little agricultural importance in York County.

Waukesha silt loam.—The topsoil of Waukesha silt loam to a depth ranging from 16 to 20 inches consists of very dark grayish-brown silt loam. It is mellow and friable, comparing favorably with Hastings silt loam of the upland. The upper subsoil layer, which reaches a depth of 30 or more inches, consists of brown heavy silt loam or silty clay loam. Although this material is heavier and more compact than the topsoil it does not constitute a claypan. It is moderately friable and can be readily crushed between the fingers. The lower subsoil layer is loose brown or yellowish-brown heavy silt loam or silty clay loam. To a depth beyond 6 feet the soil does not contain sufficient lime to effervesce with acid.

Waukesha silt loam ranks third in area among the soils of York County occupying more than 7 per cent of the total area. It occurs in continuous strips bordering either the streams or the first bottoms along Big Blue River, West Fork Big Blue River, Beaver Creek, and Lincoln Creek and a few of their larger tributaries. These strips range from a few rods to a mile or more in width. The soil has developed from alluvial sediments which were deposited by streams when they were flowing at higher levels than at present.

The surface relief of Waukesha silt loam is flat or very gently rolling, and the soil is well drained. As a rule the terraces lie well above overflow and have sufficient slope downstream to carry off surplus water.

The large total area of this soil and its high productiveness make it important in the agriculture of the county. Corn yields are slightly higher than on the upland soils, the average yield being about 48 bushels to the acre. Wheat yields 20 bushels, oats 35 bushels, barley 30 bushels, and alfalfa about 3 tons of hay to the acre. Alfalfa can be used more often in rotations on this soil than on Hastings silt loam without a noticeable decline in yields, owing to the higher and more uniform moisture content in this soil. Small grains, with the exception of barley, make no higher average yields on the terraces than on the uplands, and in years of unusually high precipitation yields are slightly lower. Although the subsoil does not contain a large amount of lime carbonate, there is sufficient to support alfalfa and other crops that require lime.

Hall silt loam.—The topsoil of Hall silt loam is very dark grayish-brown silt loam from 16 to 20 inches in thickness. The upper part of this layer is loose and structureless but the lower part is granular. The upper subsoil layer is dark grayish-brown moderately compact silty clay loam ranging from 12 to 20 inches in thickness. Beneath this and continuing to a depth of 8 feet below the surface is a layer of loose light grayish-brown structureless silt or silt loam. Lime is abundant in this layer both in finely powdered form and in concretions. The profile of this soil is similar in most respects to that of Hastings silt loam of the upland. It differs from that soil in having a heavier texture and a more compact upper subsoil layer. Hall silt loam in most characteristics closely resembles Waukesha silt loam, and the separation of the two soils on the soil map is based mainly on the larger proportion of lime and clay in the subsoil of Hall silt loam.

Hall silt loam occurs on the higher terraces of Lincoln Creek, Beaver Creek, and West Fork Big Blue River. The total area is 8½ square miles.

Hall silt loam has about the same agricultural value as Waukesha silt loam. The heavy layer of the subsoil, however, does not control the passage or storage of soil water; at least, any such influence on the amount of available soil moisture does not appreciably affect crop yields in normal years. Hall silt loam has a higher lime content and will probably maintain its high production of crops, especially of alfalfa, for a longer time without the addition of lime than will Waukesha silt loam.

Judson silt loam.—Judson silt loam consists of almost black mellow and faintly granular silt loam to a depth of more than 4 feet. The dark color is due to the high organic-matter content in the original sediments and not to the accumulation of plant remains subsequent to their deposition.

This soil is confined to small bodies occurring near the base of upland slopes or on alluvial fans formed by sediment deposited near the mouth of drainage ways issuing from the uplands. The largest area, comprising about 160 acres, borders the stream channel along Beaver Creek about 2 miles northwest of Charleston. A smaller body is along Lincoln Creek north of Bradshaw, and small areas

occur along tributaries to Beaver Creek and West Fork Big Blue River in the western part of the county.

Judson silt loam is naturally very strong and productive because the material composing it is largely topsoil carried down from the uplands. The soil is well drained and has a high moisture-retaining power. Although lime is not abundant, it is apparently not deficient. Practically all the land is under cultivation. It is considered slightly superior to the Waukesha and Hall silt loams for general farming and almost equal to Wabash silt loam for corn and alfalfa production. Owing to its small total extent, however, it is of little agricultural importance in York County.

Wabash silt loam.—The topsoil of Wabash silt loam to a depth ranging from 15 to 18 inches is very dark grayish-brown or almost black silt loam or heavy silt loam. The clay content is not sufficient to hinder cultivation, and the soil can be worked under a rather wide range of moisture conditions. The subsoil is moderately compact silty clay loam to a depth of more than 4 feet. It is well supplied with organic matter and is almost as dark as the topsoil. Neither topsoil nor subsoil contains sufficient lime to react with hydrochloric acid, but crop yields indicate no deficiency of lime for plant needs.

Wabash silt loam is considered the strongest corn and alfalfa soil in Nebraska, and in many counties where it occurs more extensively it is used almost exclusively for these crops. In York County, however, only about 80 per cent of the land, including the wide strip along Lincoln Creek, is under cultivation. Most of the remainder occurs in strips too narrow for profitable farming and is used for pasture or hay land.

Corn on this soil yields from 40 to 60 bushels to the acre, and alfalfa from 3 to 3½ tons of hay. Wild hay yields about 1 ton to the acre. The unusually high yields of these crops are owing largely to the uniformly high moisture content of the soil. The soil receives considerable moisture through seepage from the uplands and terraces. It has high moisture-retaining powers, and crops seldom suffer from drought even during prolonged dry spells.

Wabash silt loam in York County is poorly adapted to small-grain crops, as the high moisture content promotes excessive growth and both wheat and oats have a tendency to lodge even during seasons of normal precipitation.

Cass very fine sandy loam.—The topsoil of Cass very fine sandy loam is 8 or 10 inches deep and consists of very dark grayish-brown or almost black very fine sandy loam. The subsoil is gray or light grayish-brown loose incoherent fine sand or medium sand which gradually becomes coarser with depth and in many places contains considerable gravel below a depth of 3 feet. It is very low in organic matter. Neither topsoil nor subsoil contains sufficient lime to noticeably react with dilute hydrochloric acid, but crop yields show no evidence of lime deficiency.

This soil, although less productive than Wabash silt loam, on account of the porous sandy character and low organic-matter content of its subsoil, is a fairly good farming soil in all but the driest years. It is one of the best truck soils in Nebraska, as it can be handled under a wide range of moisture conditions, warms up early in the spring, and responds well to applications of manure. In York

County, however, it occurs in but few places in strips sufficiently wide to warrant cultivation and is practically all used for pasture land. The sand and gravel of the subsoil is locally used in concrete construction and for highway surfacing.

Included with Cass very fine sandy loam on the soil map of York County are numerous small bodies of fine sandy loam and a light-colored sand. The combined area of these soils does not exceed 200 acres and the individual bodies are too small to be indicated separately on a small-scale map. These soils differ from Cass very fine sandy loam and from one another in the texture of their topsoils. The topsoil of the fine sandy loam is slightly coarser than that of Cass very fine sandy loam. The sand is coarser and lower in organic matter, being gray incoherent fine sand or medium sand. The subsoils of the three soils are similar in all characteristics.

AGRICULTURAL METHODS AND RECOMMENDATIONS FOR THE IMPROVEMENT OF YORK COUNTY SOILS

The agricultural methods and management in York County are similar to those practiced throughout eastern Nebraska. Corn is planted between the first and the middle of May, the greater part being planted in checkrows and the rest listed in. The former method requires plowing, disking, and harrowing the land prior to planting the seed. Listed corn requires no seed-bed preparation beyond that furnished by the lister but is thought by most farmers to yield somewhat lower than planted corn, owing probably to inadequate preparation of the seed bed. The corn crop is cultivated three or four times during the season, 2-row cultivators being commonly used. The last cultivation is usually given early in July, after which the crop is laid by and receives no further attention until harvest, except that the more injurious weeds are removed by hoeing.

The corn crop matures in September or early October, depending on the season. The greater part is husked from the standing stalks, after which cattle and horses are pastured in the fields during the winter. On many farms part of the corn is cut for winter roughage. On farms equipped with silos, from 15 to 20 acres of corn are cut each year for silage. Silage corn is usually cut with a corn binder when the grain is still in the dough stage, and is hauled to the silage cutter while the stalks are green. Many farmers annually fence off a few acres of unhusked corn for fattening hogs and cattle, thereby saving part of the expense of husking.

The chief varieties grown are Reid Yellow Dent and Iowa Silvermine, but careful seed selection is not generally followed. Many farmers purchase seed grown outside the county. This practice is not usually rewarded by the highest yields because such seed, although belonging to one or another of the varieties known to be well suited to the county, may have become adapted to different climatic and soil conditions than those under which it is to be used. The State experiment station at Lincoln recommends the selection of seed from corn known to have been grown in the locality and known to have become adapted to local climatic and soil conditions. Corn usually follows small grain or alfalfa in rotations, although on

many farms, especially on tenant farms, it is grown on the same land five or six years in succession.

Practically all the wheat grown in the county is of the winter varieties, chiefly Turkey and Kanred, the latter variety being grown more extensively each year as it is more hardy and its average yield is about 10 per cent higher than that of the Turkey variety. The land to be used for wheat is usually plowed and harrowed during late summer, and the seed is planted with a press drill late in September. Some seed is drilled in between the corn rows early in the fall, and the crop usually makes a good growth before killing frosts occur. It remains dormant during the winter, resumes growth in early spring, and usually matures early in July. It is cut with a binder or header, depending on the length of the stems, and is either shocked or stacked for threshing. Wheat is usually grown on the same land two years in succession and generally follows oats in the crop rotation. The wheat yield is sometimes reduced by stinking smut, which distorts the kernels, prevents their normal growth, and gives the grain an offensive odor. This form of smut may be controlled by mixing the seed, before planting, with copper carbonate powder at the rate of 2 ounces of the powder to a bushel of grain.[2]

Oats are not considered a very profitable crop in York County but are desirable for feed. They are of value in crop rotations between corn and wheat. Oats are seldom planted on the same land two years in succession. They are planted and harvested in the same manner as wheat, but the land is prepared and the grain planted in the spring instead of the fall. All the crop is usually consumed on the farm where produced. Kherson is probably the chief variety grown, as it yields well, is early maturing, and has a short stiff stem which reduces the danger of lodging. Nebraska No. 21 is also an important variety and is being grown more extensively each year, as it has the better qualities of the Kherson, from which it was selected as a pure strain, and in addition yields somewhat higher. Seed selection is not carefully practiced, the common method being to clean a sufficient amount of seed from the previous crop. Smut sometimes lowers oat yields during prolonged periods of rainy or cloudy weather. The injury from this source, however, can be controlled by killing the smut spores on the seed before planting. This may be done by sprinkling the seed, after the grain has been fanned, with a solution consisting of 1 pint of formaldehyde to 35 gallons of water.

Winter rye is generally grown for the grain and to some extent for hay and pasture. The land for rye is prepared in the same manner as for winter wheat. The seed is planted with a press drill early in the fall. The crop is usually cut in July with a binder and shocked or stacked for threshing. The grain is fed locally to hogs.

Barley is grown on a few farms for feed. The common 6-rowed smooth-bearded type is regarded as superior for Nebraska conditions and has proved more productive than any of the beardless varieties. The land to be used for barley is prepared early in the spring. The

[2] NEBRASKA COLLEGE OF AGRICULTURE, DEPARTMENTS OF AGRONOMY AND PLANT PATHOLOGY. CEREAL SMUTS AND THEIR CONTROL. Nebr. Agr. Col. Ext. Circ. 126, 8 p., illus. 1926.

seed is planted and the crop harvested in the same manner as oats. Practically all the barley is used as hog feed.

Alfalfa is grown more extensively in Nebraska than in any other State and is the leading hay crop in York County. The varieties grown are among the most hardy obtainable, including Common, Grimm, and Cossack, all of which are resistant to winterkilling. Alfalfa seed is usually sown either in April or August. Thorough seed-bed preparation is important in obtaining a stand. Early plowing followed by sufficient disking, harrowing, and possibly rolling, to control weed growth and compact the soil, is desirable in most places. The best results are obtained by planting the seed after the first heavy rain. The standard seeding rate is 15 pounds of good seed to the acre, and pure certified seed should be used. Except under extremely favorable conditions, planting with a press drill is more successful than broadcasting the seed. Drilled seed should not be planted deeper than 1 inch. When the seed is broadcast it is usually covered with a harrow.

It is customary to allow a stand of alfalfa to remain from six to eight years, or as long as it remains profitable. A field is rarely frozen out. The crop is usully cut three times during the summer, and occasionally a fourth cutting is obtained. The average yield in York County was 2.7 tons to the acre in 1927. The common practice is to stack the hay in the field and haul it to the feed lots as needed. It is fed to cattle and hogs but seldom to horses because of its laxative properties. Many farmers run hogs in the alfalfa fields during summer. Cattle, however, are seldom allowed to graze for long periods on green alfalfa on account of the danger of bloating.

Some wild hay is still produced in York County. Most of it is cut from depressions throughout the uplands or in the lower-lying parts of the bottom lands where drainage is insufficient for the production of cultivated crops or tame hay. The greater part of the hay is cut from water-loving grasses and sedges and is rather coarse in texture. Some hay of excellent quality, however, consisting chiefly of bluestem and wheatgrass, is produced in the better-drained situations. Most of the hay is either stacked in the fields or stored in barns for winter feeding, and a small amount is baled.

Sweetclover, although of minor importance, is being grown more extensively each year, especially throughout the uplands. The plant is a biennial and dies at the end of the second season after producing seed. It is used chiefly for pasture and to some extent for hay and seed. When hay is desired the crop is usually cut during the first year before the growth becomes coarse and weedy. The second year the crop may be allowed to mature and reseed itself, or it may be cut with a binder and threshed for seed. The permanence of a sweetclover stand depends entirely on its ability to reseed, and care is usually taken during the second year not to graze so closely as to prevent the maturity of enough of the crop to reseed the land.[8] Seeding during two consecutive years at the start is recommended to provide for annual reseeding and also for continuous late and early pasture. The most common time of seeding is in early spring, either

[8] STEWART, P. H., and GROSS, D. L. SWEETCLOVER IN NEBRASKA. Nebr. Agr. Col. Ext. Circ. 122, [16] p., illus. 1923.

late in March or early in April. The seed bed is prepared in a similar manner to that required for alfalfa, and the seed is generally sown broadcast and covered with a harrow. Some seed is planted with a press drill, which usually insures a more uniform stand. From 15 to 20 pounds of unhulled seed are ordinarily used when seeding broadcast, and this may be reduced to 12 pounds where a drill is used.

Sweetclover has an unusually wide adaptation, as it thrives on either comparatively wet or dry soils and on soils of either light or heavy texture. It is very valuable for soil improvement, and many farmers state that it is more satisfactory for this purpose than either alfalfa or clover. It is adapted to shorter rotation systems than alfalfa and will probably improve the productivity of the soil as fast as that crop. The roots are large and vigorous and decay rapidly at the end of the second years' growth. The crop not only adds organic matter to the soil but, in common with other legumes, has the power of fixing atmospheric nitrogen in nodules on the roots. It is a good soil binder and is especially valuable on the steeper valley slopes where erosion is severe.

Mixed stands of timothy and clover are grown for hay on a few farms. Most of the crop is grown on the bottom lands and lower terraces where moisture conditions are most favorable. The land is prepared in a similar manner to that used for alfalfa or sweetclover. The seed is usually sown broadcast at the rate of 10 or 12 pounds of timothy and an equal amount of red-clover seed to the acre. It is covered by harrowing. This mixture of hay has a high nutritive value and forms a well-balanced ration, as the timothy is rich in carbohydrates and the clover has a comparatively high protein and fat content. Most of the hay is fed to work animals.

No commercial fertilizer is used in York County. Considerable barnyard manure is produced, but in general little care is taken to preserve it. On most farms the manure is piled out of doors where much of its fertilizing value is lost by leaching. The manure is hauled in the fall or spring and is generally spread on land to be used for wheat or corn. On tenant farms little care is taken to apply the manure where it is most needed, and the greater part is spread on the land near the barnyard.

SOILS AND THEIR INTERPRETATION

York County is in the prairie region of the United States where the climate has favored a luxuriant growth of grasses. Except in comparatively small eroded areas, on the steeper slopes, the soils of the county all show the influence of the grass vegetation in the dark color of their topsoils. This color is imparted by finely divided organic matter derived from the decay of grass roots and mixed with the mineral soil constituents.

The more extensive soils of the county have friable or only moderately compact subsoils, most of which include a zone of lime accumulation. The precipitation of the region, about 28 inches per annum, has not been sufficient to leach the calcium carbonate from the entire soil but has removed it from the upper soil layers to the lower part of the subsoil, causing an unusually large accumulation of this

material in that layer except where drainage is very poor or erosion severe.

The more extensive soils of York County are of granular structure in their topsoils and are more coarsely granular, nutlike, or cloddy in their subsoils. The topsoils and subsoils have developed layers, or horizons, which differ from one another in one or more important features, such as color, lime content, texture, structure, or compaction.

The characteristics mentioned are not everywhere equally expressed. They are the result of the climate and vegetation under which the soils have developed and are typically expressed only in those soils which have received the full impress of their climatic and vegetative environment. Such soils occupy well-drained uneroded parts of the county where conditions have been most favorable for prolonged undisturbed weathering. In these situations the soil-forming processes, including leaching, oxidation, aeration, and the accumulation of organic matter, have acted to their full capacity, as governed by their environment. The soils, therefore, have reached a stage of development which is normal for the existing climate and vegetation and are fully developed.

The soil characteristics derived from the climate and vegetation occur in varying degrees of development in nearly all the soils of the county. The stage of development depends on the relief, drainage, character of the parent soil materials, and the length of time the materials have been subjected to undisturbed weathering. In the early stages of soil development the parent materials were the controlling factors in determining the character of the soils. As time went on, however, the processes of soil formation gradually altered the upper part of the parent materials to a degree depending on the topographic and drainage conditions under which the processes were forced to act, the length of time they acted, and the relative resistance of the parent materials to their action.

Soils in which one or more of the features common to fully developed soils are either absent, poorly expressed, or excessively expressed are regarded in this report as imperfectly developed. There are in York County two broad groups of soils, namely, fully developed, or normal soils, and imperfectly developed soils.

Normal soils occupy about 80 per cent of the land area in the county. They occur throughout the uneroded and well-drained parts of the uplands and are locally developed on the terraces. Topographic and drainage conditions have especially favored deep soil weathering. Nearly all the characteristics common to the parent geologic materials have either been obliterated or so completely altered by the soil-forming processes that they are scarcely noticeable in the soils. The soils owe their major characteristics almost entirely to the climate and vegetation under which they have developed.

The topsoils of normal soils consist of three well-defined layers, all of which are rather friable. The upper layer is a loose structureless mulch, in few places exceeding an inch in thickness. It is dustlike when dry. The second layer, from 2 to 5 inches thick, is laminated, the soil particles being grouped into thin, horizontal, disklike, very fragile plates which overlap one another. The lowest layer of the topsoil, which is from 12 to 18 inches thick and extends to an average depth of 20 inches, is decidedly granular. The soil particles

are grouped into small rounded and subangular aggregates ranging from one-sixteenth to slightly more than one-fourth inch in diameter, the larger aggregates being most abundant in the lower part of the layer. The granular layer may or may not be columnar; where it is columnar that arrangement is rarely pronounced.

The mineral constituents of the topsoils are chiefly very fine sand and silt. Very fine sand is generally most abundant in the surface mulch and in places gives that layer a very fine sandy loam texture. The proportion of silt and sand, however, does not vary greatly in the different layers, and the topsoils of the group average silt loam in texture. They are rich in organic matter and prevailingly dark in color. The distribution and stage of decomposition of the organic constituents, however, is not uniform, and the intensity of the dark color varies slightly in the different layers, the laminated layer being the darkest, as it contains the largest amount of thoroughly decomposed carbonaceous material. The color remains constant when the soil material is pulverized, indicating that the organic matter is thoroughly mixed with the mineral soil particles. The structureless mulchlike covering is lightest in color. The organic constituents are very abundant and are uniformly distributed throughout the layer but are not all thoroughly decomposed, and the soil material is dark grayish brown or grayish brown. In the granular layer decomposition of the plant remains is complete, but the organic matter is not sufficiently abundant to thoroughly permeate the soil material as in the overlying layer and is confined largely to a film or coating on the surfaces of the granules. The film is thickest in the upper part of the layer, causing a natural exposure of that part to appear as dark and as rich in organic matter as the overlying layer. The granular material when crushed, however, becomes lighter in color than similarly treated material from the laminated layer, indicating a lower organic-matter content per unit of soil volume. The lower part of the granular layer is dark grayish brown or, when crushed, grayish brown.

The fourth layer is the upper subsoil layer and the one of maximum compaction, being invariably denser than any other layer. This layer is about 12 inches thick and extends to an average depth of 32 inches. The degree of compaction varies somewhat in different soils, depending on topographic and drainage conditions. The increased compaction has been caused by the translocation of the finer-textured particles of the topsoil through the agency of percolating waters, and the layer is densest in those situations where surface drainage has been rather slow. An extremely compact or claypanlike layer, however, does not occur in the normal soils of York County, the layer of maximum compaction being only moderately compact silty clay loam.

The soil material in the layer of maximum compaction contains less organic matter than that in the overlying layers and is grayish brown or dark grayish brown. It varies somewhat in structure but in most places is composed of more or less cubical or prismatic structural units, few of which exceed three-fourths inch in their longest dimension. The organic matter is largely confined to a film or coating on the surfaces of the structural particles. The film is somewhat thinner than in the overlying layers, as is indicated by the lighter color of the layer.

The fifth layer, which is transitional in character between the zone of compaction and the lime zone, is columnar, the columns ranging from 4 to 5 inches in diameter. They apparently have no definite structure, although they contain numerous horizontal seams and cracks at irregular intervals and break naturally into angular clods of various sizes and shapes. The material is grayish brown and faintly compact in the upper part of this layer but becomes rapidly lighter in color and looser with depth, being light grayish-brown flourlike silt in the lower part. In most places it merges with the lime zone at a depth ranging from 4 to 5 feet.

The lime zone is composed of floury more or less columnar light grayish-brown or almost white silt which contains very little organic matter. An abundance of lime, occurring chiefly in soft and semi-hard concretions and in finely divided form, is thoroughly mixed with the silt. The maximum lime concentration is in the upper 12 or 15 inches of the zone.

Below a depth of 6 or 7 feet is the formation from which the soils have weathered. It is columnar but otherwise structureless and is composed of light-gray or buff calcareous and floury silt, a material geologically known as loess. It extends to a depth of more than 12 feet without noticeable change in texture, structure, or color. The loessial material, although calcareous, contains much less lime per unit of soil volume than the overlying lime zone, and shows no evidence of concentration or segregation of the carbonates.

The normal soils contain worm casts and twisted rodlike forms of various lengths in all layers beneath the laminated one. The casts are usually most abundant in the granular layer, and the rodlike forms occur chiefly in the layer of maximum compaction. The worm casts are more or less spherical and are about one-sixteenth inch in diameter. They may be grouped in rounded clusters including from 10 to 25 casts or may occur as fillings in old root or insect cavities. The rodlike forms, often called "borings," are also fillings in root, worm, or insect cavities and may at one time have consisted largely of worm casts, but if so the casts in most places have become obscured and the material comprising them is blended into a uniform mass. Most of the borings and casts are either lighter or darker than the general color of the layer in which they occur, depending on whether the material composing them was derived from overlying or underlying layers.

In the group characterized by the profile described may be placed the Hastings soils of the uplands and the Hall soils of the well-drained terraces. These soils are essentially alike. They are separated on the accompanying map because of differences in the mode of accumulation of the loessial materials from which they have weathered. The upland loess from which the Hastings soils have developed has lain undisturbed since its deposition, whereas that which has weathered into the Hall soils consists of sediments derived from the uplands and deposited on the valley floors when the streams were flowing at higher levels.

The imperfectly developed soils, although rather numerous, occupy only about 20 per cent of the total county area. They differ from the soils of the group previously described in that they have not received the full impress of the regional climatic and vegetative environment. One or more of the layers is excessively developed,

poorly developed, or absent, and in a few places the soils may contain more layers than occur in fully developed soils. Normal development has been prevented by counteracting agencies such as insufficient time, resistance to weathering of the parent soil materials, poor drainage, or excessive erosion. These have in few places acted independently, but one or another of them is largely responsible for preventing any particular soil from attaining normal development. All soils of the imperfectly developed group have made some progress toward normal development, the degree depending on the relative resistance of the counteracting agencies mentioned.

For convenience in description the soils of the imperfectly developed group may be seperated into subgroups on the basis of the factor or group of factors instrumental in preventing normal development. The first subgroup includes the soils in which normal development has been prevented chiefly by insufficient time and is represented by the Judson and Waukesha soils. The Judson soils have developed on materials recently removed from the loessial uplands by surface wash or colluvial action and deposited near the base of the more gradual slopes, on narrow valley floors, or on gently sloping terraces. The deposits are dark having been derived chiefly from the dark surface layers of upland soils. Sufficient time has not elapsed for the development of definite zones or layers. The soils derived from these deposits are very dark grayish brown or black, have no definite structure, and are uniform in color and texture below a depth of 4 or 5 feet. They do not contain sufficient lime to produce noticeable effervescence when dilute hydrochloric acid is applied.

The Waukesha soils have developed on the lower terraces from loesslike parent material similar to that underlying the Hall soils but more recently deposited. Both topographic and drainage conditions are especially favorable for undisturbed weathering, and the soils are transitional in development between soils of the Wabash and Hall series. They resemble Hall soils in all characteristics except lime content. The soils have probably not lain in their present position long enough to have received the full impress of the regional environment, as is indicated by the absence of a zone of lime accumulation in the subsoil. It may be, however, that conditions favorable for rapid leaching have prevented the accumulation of lime in this soil. The Waukesha soils are considered as being normally developed in more eastern counties of Nebraska and throughout Iowa, where the absence of a lime zone is due to increased rainfall and soil leaching and not to insufficient soil weathering.

The second subgroup of imperfectly developed soils in York County comprises the soils in which normal development has been prevented largely by erosion. This subgroup includes the slope phase of Hastings silt loam, Nuckolls loam, and Shelby loam, each of which occupies sloping positions along valley sides and has been subjected to more or less erosion, the amount depending on the gradient. In general the Nuckolls and Shelby soils occupy the steeper slopes, and the slope phase of Hastings silt loam occupies the more gradual ones. All the slopes, however, vary in steepness, and none of the soils is uniform throughout the area of its occurrence.

Where erosion has not been especially severe the topsoils have accumulated considerable organic matter and are very dark but are every-

where much thinner than in normal or fully developed soils. On the steeper slopes the weathered soil has been removed almost as fast as it has formed, and the material from which the soils are weathering is either exposed or is near the surface of the ground. One or more of the features resulting from prolonged undisturbed weathering are feebly expressed or absent in all soils of this subgroup, and the parent geologic formations have everywhere exerted a strong influence in determining soil characteristics.

The slope phase of Hastings silt loam differs from typical Hastings silt loam in those features which are the direct result of surface erosion, and the degree of variation from the typical soil is dependent on the amount of erosion. Where the phase occupies rather gradual slopes and surface run-off is moderate the soil differs from true Hastings silt loam only in its thinner topsoil. Where erosion is most severe the phase has neither topsoil nor subsoil but consists of exposed unweathered loess similar to that underlying Hastings silt loam. Between these two extremes are all degrees of slope and erosion, with corresponding variations in the character of the soil. Most of the slope phase has a topsoil about half as thick as that of typical Hastings silt loam.

The Nuckolls soils have been formed under essentially similar topographic conditions to those prevailing in the slope phase of Hastings silt loam, but they are developed from parent material known geologically as the Loveland phase of the loess. This material is pale-red friable silt containing some sand, chiefly of the finer grades. It underlies the light-gray practically sand-free loess of the uplands and is thought to be older and more oxidized. It is exposed only locally on the valley slopes.

The rapid surface run-off in most places has prevented the accumulation of much organic matter, and the topsoils of the Nuckolls soils in few places exceed 4 or 5 inches in thickness. They are composed largely of friable dark grayish-brown granular silt loam or loam. This layer is underlain by slightly more compact pale reddish-brown silty clay loam, extending to a depth of about 3 feet, which has a faintly columnar form and a nutlike or small-clod structure. The lower subsoil layer is the zone of lime accumulation, the carbonates occurring both in finely divided form and as numerous hard and soft concretions. The red tinge is more pronounced than in the layer above, and the layer presents a mottled reddish-brown and white appearance. It is faintly columnar but otherwise structureless. Beneath the lime zone is the unweathered pale-red Loveland loess from which the soil has developed. This profile is typical of the average Nuckolls soil in York County, but in numerous places the topsoil has been entirely removed by erosion, and the reddish-brown subsoil is exposed.

Shelby loam has weathered from a reddish-brown mixture of sand, clay, and cobblestones of glacial origin which underlies the Loveland phase of loess and is exposed locally on a few of the lower valley slopes. The topsoil is variable owing to differences in the degree of slope and amount of erosion. On the steeper slopes it is either very thin and rather light in color or is entirely removed, whereas in the more protected situations it may be 8 or 10 inches thick and almost black. The upper part is generally structureless to a depth ranging from 1 to 4 inches, and the remainder is finely granular, the granules

being vague in outline and intermixed with considerable structureless material. The topsoil, where present, invariably contains some sand and gravel.

The upper subsoil layer, extending to an average depth of about 2 feet, is sandy clay loam which is slightly more compact than the topsoil but has a higher sand and gravel content. The remainder of the subsoil becomes gradually lighter and browner in color with depth but does not noticeably change in texture or consistence. It gives way rather abruptly at a depth of about 4 feet to reddish-brown sand and gravel loosely held together with silt and clay. Neither the topsoil nor subsoil contains sufficient lime to noticeably react with dilute hydrochloric acid.

The third subgroup of imperfectly developed soils includes those of the Crete, Butler, Fillmore, Scott, Wabash, and Cass series. The first four owe their imperfect development almost entirely to poor drainage. The last two soils have formed from recently deposited alluvium, and although normal development has been prevented largely by poor drainage the youthfulness of the deposits from which the soils are weathering is also an important factor in retarding normal soil development.

The stages of development attained by the Crete, Butler, Fillmore, and Scott soils are not clearly understood. These soils occupy shallow basinlike depressions throughout the loessial uplands, and in the order named have developed under increasingly poor drainage conditions. Although subjected to excessive moisture, they all show one or more of the characteristics common to normally developed soils. Some of the characteristics, especially those of the subsoil, are even better developed than in the Hastings and Hall soils and become more and more pronounced as the drainage decreases. Other characteristics, however, chiefly those in the topsoils, become less and less pronounced under decreasing drainage. Possibly all soils of the Crete, Butler, Fillmore, and Scott series were formerly well-drained normally developed soils which have been altered by poor drainage. If so, the alteration has progressed gradually as the moisture to which the soils have been subjected became increasingly excessive. On the other hand these soils may never have attained normal development, owing to poor drainage conditions throughout all stages of their formation. Regardless of the stages of development attained by them, they all differ in one or more respects from the normally developed Hastings and Hall soils and are therefore classed with the imperfectly developed soils of York County.

The Crete soils, although more poorly drained, on account of their location in depressions, than the Hastings soils, have been less affected by excessive moisture than the Butler, Fillmore, and Scott soils. They occur only in the shallower and better-drained depressions, or parts thereof, throughout the uplands. The surface runoff, although too slow to prevent the soil from occasionally becoming saturated, is fairly well established, and no part of the Crete soils is subject to prolonged inundation. The one member of this series in York County is nearly normal in development, differing from the Hastings soil only in the higher clay content and greater compaction of its upper subsoil layer. This layer, as in the Hastings soil, was formed by the downward translocation of finer-textured topsoil par-

ticles through the agency of percolating waters, and since downward seepage is naturally greater in depressions than on areas with good surface drainage the Crete soil has developed a much denser upper subsoil layer than the Hastings soil.

The Butler soils have been subjected to more excessive moisture than the Crete soils, but to less than the Fillmore. Few of the depressions in which the Butler soils occur have drainage outlets, and water often accumulates in them after heavy rains. Few of them are more than a foot or two deep, however, and do not receive surface run-off from such large areas as do the Fillmore or Scott soils.

The topsoils of the Butler soils are about 16 inches thick. They are rather friable, are almost black, and include three layers—a structureless surface mulch from one-half to 2 inches thick, a laminated layer from 2 to 4 inches thick, and a granular layer which comprises the remainder of the topsoil. The granules in the lower layer are irregular in shape and vary somewhat in size, but few of them exceed one-fourth inch in diameter. They generally contain a sprinkling of almost white flourlike silt, which becomes more concentrated with depth and in some places considerably lightens the naturally dark color in the lower 2 or 3 inches of the granular material.

The subsoil includes two layers. The upper layer is a true claypan which is considerably more compact than the corresponding layer in the Crete soil. It is about 20 inches thick and consists of very dark grayish-brown or black comparatively impervious clay which has a dull appearance even when moist. The material is structureless and breaks into irregular-shaped angular lumps of various sizes. The lower subsoil layer, occurring below an average depth of 40 inches, is the layer of carbonate accumulation and consists of loose gray or light-gray silt or silty clay loam containing scattered rust-brown stains and an abundance of lime. The carbonates are most concentrated in the upper 4 to 10 inches of the layer, where they occur chiefly as soft and hard concretions. In the remainder of the layer the lime is chiefly in disseminated form and becomes less abundant with depth.

Beneath the lower subsoil layer is loess, a yellowish-gray floury siltlike deposit containing scattered rust-brown stains and spots. The material is not calcareous to a depth below 8 or 10 feet.

The Butler soils differ from the Crete soils in the darker color of their claypan layers, and they differ from the Fillmore soils in the better development of their granular layers and in the total absence of hard large black concretionary forms in the claypan.

The Fillmore soils, in general, occupy depressions and are transitional in drainage and development between the Butler and Scott soils. During their formation they were subjected to more moisture than the Butler soils but less than the Scott soils. The topsoils range from less than 6 to about 10 inches in thickness. They are extremely variable but in most places include three layers. The upper layer is structureless or semigranular and is from one-half to 1 inch thick, the second is laminated and is about 4 inches thick, and the third is imperfectly granular and is from 3 to 10 inches thick. All the layers

are rather friable. One or more may be absent, and in a few places the upper subsoil layer may extend to the surface of the ground. The color of the topsoil ranges from dense black to light gray. The lighter shades are caused by the almost white floury silt which occurs in greater or less abundance in all places. It may be a mere sprinkling, scarcely noticeable, on the surfaces of almost black structure particles or it may be concentrated, especially in the lower part of the topsoil, making that part almost white. Both forms of distribution are commonly present, but they vary greatly in the intensity of their expression.

The subsoil includes two layers. The upper one is a true claypan, being extremely dense black clay which ranges from 6 to 24 inches in thickness and occurs at a depth ranging from a few inches to slightly more than a foot below the surface of the ground. The dense clay is structureless and breaks into irregular-shaped clods of various sizes. It contains scattered black hard round concretionary forms from one-sixteenth to slightly more than one-fourth inch in diameter.

The lower subsoil layer is gray, light-gray, or almost white loose structureless silt loam or silty clay loam containing scattered rust-brown stains and specks. Lime is abundant in the upper 8 or 10 inches of the layer, occurring chiefly as hard and soft concretions. Below the concretionary lime most of the carbonates are disseminated. All lime decreases with depth, disappearing below a depth of about 6 feet, or at the lower limits of the layer.

Beneath the subsoil is loessial material similar to that from which the Butler soils have weathered. The loess under the Fillmore soils of York County is not calcareous to a depth below 7 or 8 feet.

The soils of the Scott series are the most poorly drained of the upland soils. They occur only in the deeper basinlike depressions and have been subjected to excessive moisture in larger amounts than the Butler and Fillmore soils. Downward water percolation, therefore, has been more continuous and its results more pronounced. The topsoils are friable or only slightly compact and range from less than 2 inches to about 10 inches in thickness. They are variable in structure but are generally more or less laminated and in few places contain pronounced granular layers. The upper one-half to three-fourths of the topsoil has an almost black basic color but in most places contains considerable light-gray or almost white floury silt which lightens the basic shade. The lower part of the topsoil may or may not be dark, its color depending on the concentration of white floury silt, and it may range from almost black to white. Where unusually light in color this part of the topsoil in many places contains numerous black hard round concretionary forms from one-sixteenth to slightly more than one-fourth inch in diameter.

The subsoil, a true claypan composed of heavy structureless clay, extends to a depth of 5 or 6 feet. Excessive moisture has given the material a steel-gray or dark bluish-gray color, in places mottled with rust-brown stains, streaks, and splotches. The claypan contains scattered black concretionary forms similar to those occurring in the lower part of the topsoil. Below the subsoil is light yellowish-gray loose floury loess similar to that underlying the Butler and Fillmore soils. It is not calcareous to a depth below 8 or 10 feet.

The Scott soils differ from the Fillmore soils, which they most nearly resemble, chiefly in the lighter and more mottled color in their claypan and in the absence of a zone of lime accumulation in the solum.

All the characteristics of the Scott soils are apparently the result of extremely excessive moisture conditions. Water often stands for periods ranging from a few weeks to several months in the depressions occupied by the Scott soils, and the vegetation in many places consists of rank growths of rushes and reeds. The subsoils are almost continually saturated and have been thoroughly leached of their carbonates.

The Wabash and Cass soils occupy flood-plain positions along streams and owe their imperfect development both to poor drainage and to the recent deposition of the sediments from which they are weathering. The moist conditions prevailing in the flood plains have especially favored vegetative growth and decay, and all the soils except those developed from the most recent alluvial deposits have dark-colored topsoils. The parent materials are so recently deposited that they have not developed into soils having characteristic zones, or layers. Oxidation and aeration in most places have been greatly retarded by excessive moisture, and in many places the topsoils rest directly on the unweathered or only slightly weathered parent alluvial sediments. The character of the sediments, therefore, is the controlling factor in determining the character of the flood-plain soils.

The Wabash soils have weathered from fine-textured sediments, largely silts and clays. They have friable, almost black, topsoils from 12 to 14 inches thick. The subsoils are moderately compact, due to a rather high clay content, and are similar to or slightly lighter in color than the topsoils. The subsoils are low in lime.

The Cass soils have weathered from the coarser-textured flood-plain sediments consisting largely of sands and gravels. These soils have accumulated considerable organic matter, and their topsoils are very dark grayish brown or almost black but are generally a little thinner than those of the Wabash soils. The subsoils are composed largely of loose gray sand and gravel, the gravel in most places becoming more abundant with depth. The soils may or may not contain lime. Where lime occurs it is in finely divided form and is evenly distributed throughout the soil.

SUMMARY

York County is in southeastern Nebraska. It is almost square and comprises 575 square miles, or 368,000 acres.

The county is in the loess region of Nebraska. About 85 per cent of the land surface, including most of the uplands, is near the level of the old constructional loess-mantled plain. The relief ranges from nearly level to strongly rolling. The greater part of the uplands is very gently undulating and is characterized by numerous shallow basinlike depressions. The remaining 15 per cent of the county includes the flat alluvial lands which occur as continuous strips of various widths along all the larger streams. The surface of the alluvial lands is nearly level except for a gentle slope down the valleys and toward the stream channels.

York County has an average elevation of about 1,650 feet above sea level. Its general slope is toward the southeast.

Drainage is effected through Big Blue River, West Fork Big Blue River, Lincoln Creek, Beaver Creek, and Indian Creek, all of which streams are roughly parallel and flow in a general easterly direction. With the exception of the depressions throughout the uplands and locally on the bottom lands, the county is well drained.

The first permanent settlement in the area now included in York County was made on West Fork Big Blue River in 1865, and the county was organized in 1870. The early settlers came largely from the East Central States. According to the 1930 census the population of the county is 17,239, of which 66.9 per cent is classed as rural. York, the county seat, has 5,712 inhabitants.

The transportation facilities of the county are good. No point is more than 9 miles from a railroad. Public roads follow most section lines.

All parts of the county are supplied with rural mail delivery; telephones are in common use; and the public-school system is highly developed.

The climate of the county is suited for growing hay, vegetables, and grain, and for raising livestock. The mean annual temperature is 51.5° F., and the mean annual precipitation is 27.89 inches. The average frost-free season is 161 days, which is ample for the maturing of all crops common to the region.

York County is essentially agricultural. Grain and hay growing, hog raising, and cattle fattening are the chief occupations. According to the Nebraska agricultural statistics, corn, wheat, oats, alfalfa, wild hay, and sweetclover were the leading crops in 1927.

Systematic crop rotation is not practiced. No commercial fertilizer is used and the supply of barnyard manure is seldom adequate for best results.

Farm improvements are, in general, good. Most farms are equipped with modern labor-saving machinery. Some tractors are used in performing the heavier work.

Farm laborers are usually plentiful except during the small-grain harvest period. Wages range from $30 to $50 a month with board and lodging.

The most extensive and agriculturally important soil in York County is Hastings silt loam. It covers all the uplands, except those parts within the basinlike depressions, and some small areas on the valley slopes of the more deeply intrenched drainage ways. It is well drained, is easy to cultivate, and ranks among the strongest and most productive of the upland soils in Nebraska. It is admirably suited to the production of all the varieties of corn, small grain, alfalfa, and other crops which are adapted to the climatic conditions of the region.

The Hall and Waukesha silt loams, although comparatively inextensive, are as strong and productive as Hastings silt loam and rank next to that soil in agricultural importance. They are very similar in most of their profile characteristics to the Hastings soil, but occupy terrace or bench positions along streams.

A group of soils situated in basinlike depressions throughout the uplands have developed claypanlike layers in the upper part of

their subsoils and are comparatively unproductive. They include the Crete, Butler, Fillmore, and Scott silt loams which, in the order named, show the results of increasingly poor drainage, both in their profile characteristics and in their productive powers. The claypan soils are rather inextensive and are of only local agricultural importance in York County.

The Nuckolls and Shelby loams occur locally on the lower valley slopes in the southern part of the county. These soils are subject to severe erosion, and, on account of their unfavorable relief, are unsuited to cultivation in most places.

Wabash silt loam and Cass very fine sandy loam occupy narrow strips in the flood plains along some of the larger drainage ways in York County. Both soils have developed on alluvial sediments deposited by the streams during periods of high water. The Wabash soil is one of the strongest corn and alfalfa soils in Nebraska but is not sufficiently extensive in York County to be of much agricultural importance.

A few small bodies of Judson silt loam are mapped. This soil has developed from dark-colored sediments carried down from the uplands by colluvial or alluvial action and deposited near the base of slopes, in narrow valleys, or on gently sloping terraces. The sediments are of recent origin and have not weathered sufficiently to have developed soils with definite zones or layers.

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[PUBLIC RESOLUTION—NO. 9]

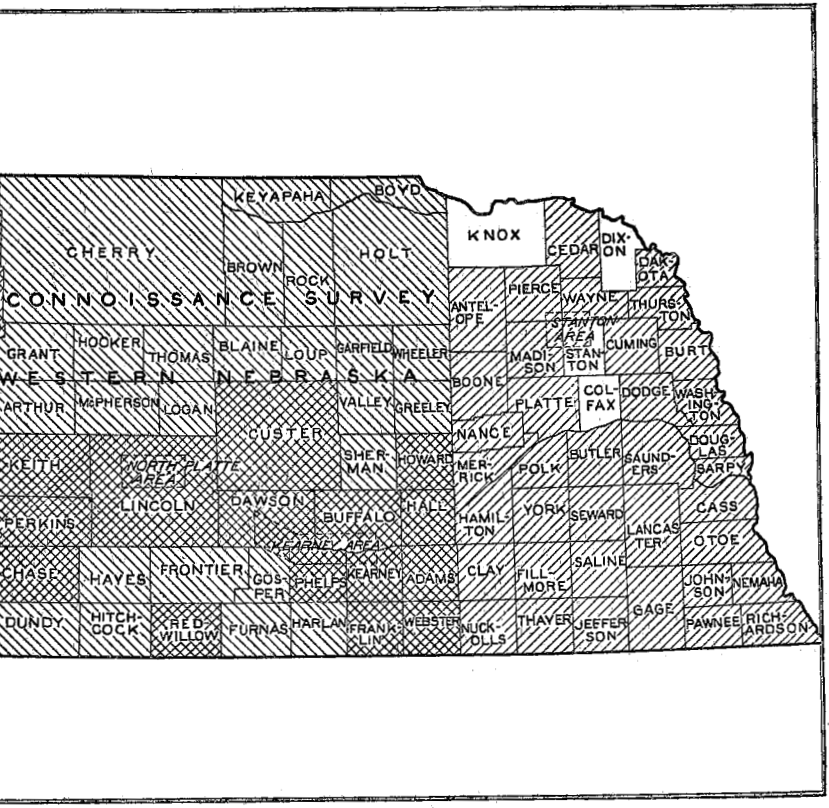
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Nebraska, shown by shading

U. S. GOVERNMENT PRINTING OFFICE: 1931

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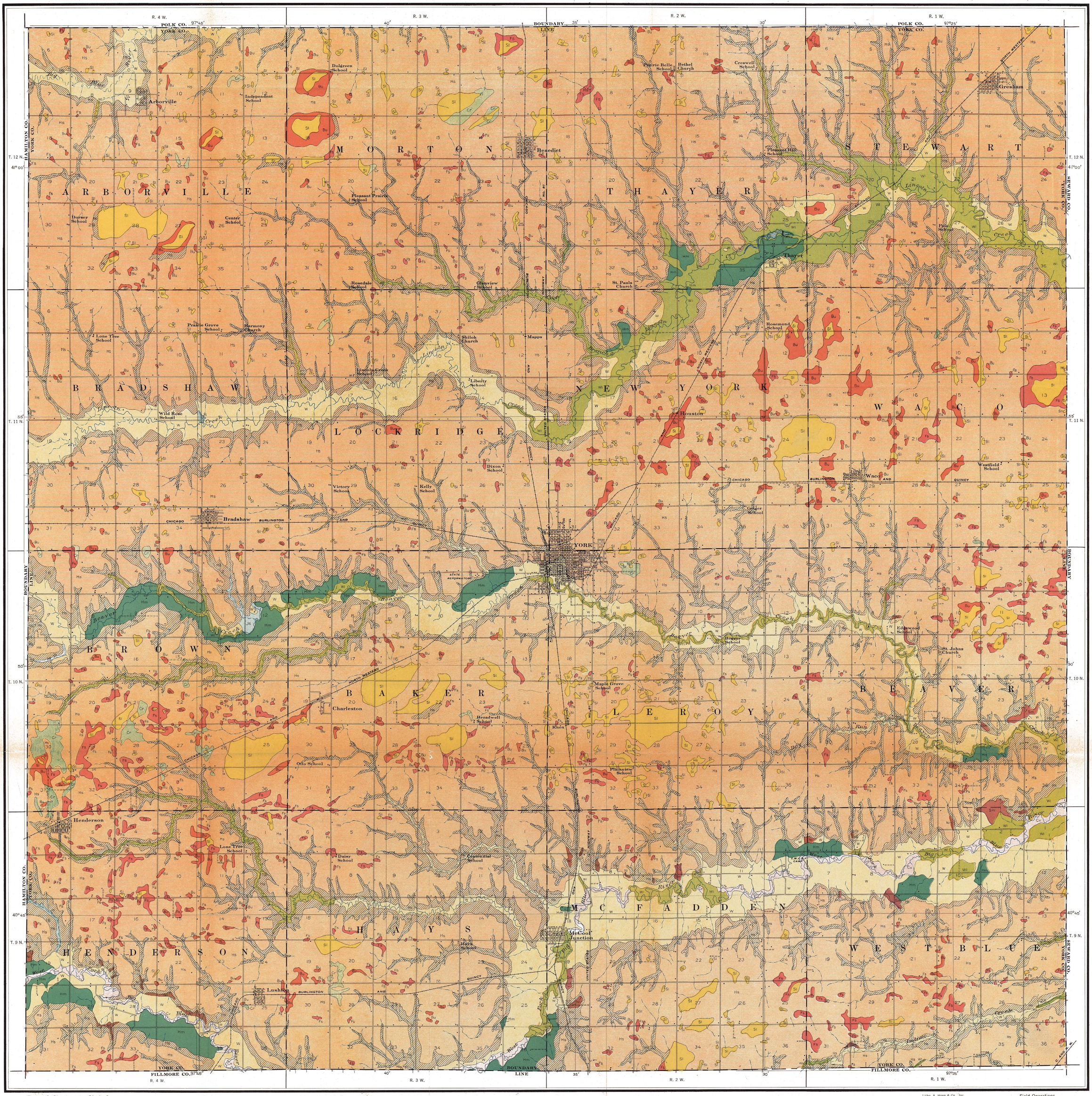
A. G. McCALL, CHIEF, SOIL INVESTIGATIONS
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP
YORK COUNTY
NEBRASKA

UNIVERSITY OF NEBRASKA
STATE SOIL SURVEY DEPARTMENT OF THE
CONSERVATION AND SURVEY DIVISION
G. E. CONDRA, DEAN AND DIRECTOR



LEGEND

Butler silt loam (Bu)	Judson silt loam (Js)
Cass very fine sandy loam (Cv)	Nuckolls loam (Nl)
Crete silt loam (Cr)	Scott silt loam (Sl)
Fillmore silt loam (Fs)	Shelby loam (Sm)
Hall silt loam (Hm)	Wabash silt loam (Wl)
Hastings silt loam (Hs)	Waukesha silt loam (W)
Hs — Slope phase	

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

- City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort.
- Secondary roads and Trails
- Railroads, Steam and Electric (DOUBLE TRACK, SINGLE TRACK, DISTANCE IN MILES, R.R. ROAD)
- Bridges, Ferry
- R.R. crossings, Tunnel (R.R. ABOVE, R.R. BELOW)
- Ford, Dam
- School or Church, Cemeteries (CEM)
- Mine or Quarry, Mine dumps, Made land
- Bluff, Escarpment, Rock outcrop and Triangulation station
- Stony and Gravelly areas
- Soil boundaries
- Boundary lines (STATE, COUNTY)
- Boundary lines (LAND GRANT, CITY OR VILLAGE)
- Boundary lines (CIVIL TOWNSHIP, RESERVATION)
- U.S. township and section lines

RELIEF
(Printed in brown or black)

- Contours, Depression contours (INTERMEDIATE, DEPRESSION)
- Prominent Hills, Mountain Peaks
- Sand, Wash, and Sand dunes
- Shore and Low-water line, Sandbar

DRAINAGE
(Printed in blue)

- Streams
- Lakes, Ponds, Intermittent lakes
- Intermittent streams
- Springs, Canals and Ditches, Flumes
- Swamp, Salt marshes
- Submerged marsh, Tidal flats

The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

Thomas D. Rice, Inspector, District 3.
Soils surveyed by F. A. Hayes, in charge, and A. W. Goke.

Scale 1 inch = 1 mile
1 ½ 0 1 2 3 4 Miles

Litho. A. Hoen & Co., Inc.

Field Operations
Bureau of Chemistry and Soils
1928